OCIO Program

Model Process Control Language (MPC)

Completed Technology Project (2003 - 2014)

Project Introduction

The MPC (Model Process Control) language enables the capture, communication and preservation of a simulation instance, with sufficient detail that it can be analyzed, augmented, aggregated, replayed and preserved without the need for the initial simulation tool or resources (infrastructure, team, tools). MPC was initially focused on 4-D (visual across time) simulations, and this is where the majority of the work has occurred. However additional domains can be supported. In the 4-D case, MPC is focused on description of state and meta information associated with each of the items and elements in a simulation. With these elements preserved, an appropriate tool can replay the simulation well past end of life for the associated simulator. This is critical when system and mission lifecycles are measured in decades and generations. An additional benefit is that the MPC representation of a simulation does not need to contain critical software codes, models or intellectual property; allowing it to be easily shared with partners (domestic or international).

MPC grew from the Constellation System Engineering and Integration (SE&I) Modeling and Simulation Teams (MaST). It was created to capture simulation data in a manner more quantitative than recorded video and a more portable than an "in tool" recording (requiring use of the tool to view the data). It allows simulation information to be preserved outside the simulation tools and re-used by other tools.

MPC data is also extensible. In the most basic case, the simulator provides time and location information. Average velocity can then be calculated from 2 time stamped, location entries; and acceleration is available from 2 velocity entries. This new information can then be written back into the MPC file for use and re-use by others.

MPC itself is extensible. Constellation held annual Confabs to partner extensions. MPC 1 consisted of a comma-delimited text file, with each line consisting of a single state definition for a single entity. Version 2 added XML encoding with additional data elements and removed the requirement to update every element every time cycle. MPC Version 3, the current version, added Parent Child Relationships, a separate configuration file to accompany the dynamic data file and standardized some of the freeform metadata into structured information. Recent additions include support for thruster and joint data types.

Anticipated Benefits

NASA's Exploration missions are multi-decadal, multi-generational endeavors. Decisions made in the 2010's, will be implemented in the 2020's and used in the 2030's. NASA simulations help develop concepts, study options, make decisions and communicate intents. However, due to the inevitable obsolescence of the computational infrastructure, the lifespan of these tools is

Model Process Control Language

Table of Contents

Organizational Responsibility

Responsible Mission Directorate:

Office of the Chief Information Officer (OCIO)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

OCIO Program

measured in years, not the necessary decades and definitely not in generations.

Quantitative preservation and communication of analysis results enables the sharing of knowledge and expertise with future teams, leaders and decision makers. MPC enables this preservation. Experience has shown the ability to preserve and re-use student simulation data (Simulation Exploration Experience or SEE) with MPC long after the simulators are not longer available. This capability to share information and knowledge across multi-generational teams is critical for NASA's long term missions.

NASA's Exploration missions are multi-decadal, multi-generational endeavors. Decisions made in the 2010's, will be implemented in the 2020's and used in the 2030's. NASA simulations help develop concepts, study options, make decisions and communicate intents. However, due to the inevitable obsolescence of the computational infrastructure, the lifespan of these tools is measured in years, not the necessary decides and definitely not generations.

Quantitative preservation and communication of analysis results today enables the sharing of knowledge and expertise with future teams, leaders and decision makers. MPC enables this preservation. Projects have already shown the ability to preserve and re-use Exploration and student team simulation data (Simulation Exploration Experience or SEE) long after the simulators are not longer available. This capability to share information and knowledge across multi-generational teams is critical for NASA's long term missions.

This ability is even more critical for future, currently unfunded, missions. Often the formulation teams for these missions are assembled only for the formulation task, with preserved results limited to papers and presentations. The team does not carry over to the subsequent development effort. The ability to quantitatively capture the analysis data in an extensible and reusable format will provide long term benefits when NASA activates these missions.

Any entity with multi-decadal or multi-generational missions will benefit from the ability to preserve, share and extend complex and rich analysis information.

NASA uses simulation develop concepts, study options, make decisions and communicate intents. Other do as well. However, due to the inevitable obsolescence of the computational infrastructure, the lifespan of these tools is measured in years, not decades and definitely not generations.

Quantitative preservation and communication of analysis results today, for use by future teams and decision makers, is of benefit to any organization with multi-decadal and multi-generational systems. The capability to share

Project Management

Program Manager:

Tracy A Bierman

Project Manager:

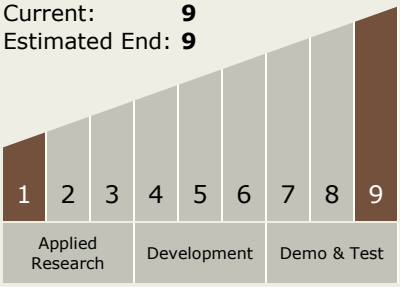
Michael P Conroy

Principal Investigator:

Michael P Conroy

Technology Maturity (TRL)

Start: **1**
Current: **9**
Estimated End: **9**



Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.3 Simulation
    - TX11.3.1 Distributed Simulation

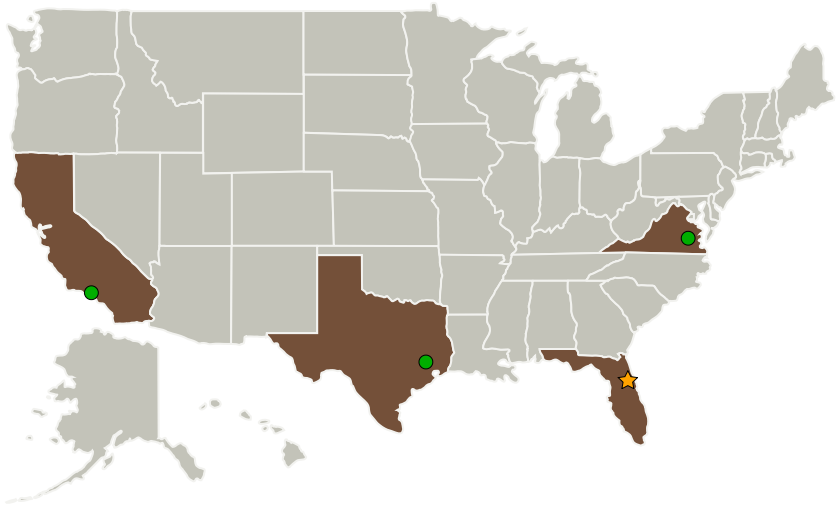
information and knowledge across multi-generational teams is critical to the success of any organization's long term missions.

Any agency with multi-decadal or multi-generational missions will benefit from the ability to preserve, share and extend complex and rich analysis information.

NASA uses simulation develop concepts, study options, make decisions and communicate intents. Other do as well. However, due to the inevitable obsolescence of the computational infrastructure, the lifespan of these tools is measured in years, not decades and definitely not generations.

Quantitative preservation and communication of analysis results today, for use by future teams and decision makers, benefits any organization with multi-decadal or multi-generational systems. The capability to share information and knowledge across generations is critical to the success of any organization's long term missions.

Primary U.S. Work Locations and Key Partners



Model Process Control Language (MPC)

Completed Technology Project (2003 - 2014)

Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
●Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
●Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas
●Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
California	Florida
Texas	Virginia

Stories

Model Process Control (MPC) Spec, version 3
(https://techport.nasa.gov/file/29654)

Simulation Enabled Lifecycle Presentation
(https://techport.nasa.gov/file/29430)

Links

NASA Model Use and Re-Use White Paper (NIMA)
(http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20120017461.pdf)